Introduction by the Minister of Technology, the Rt. Hon. Anthony Wedgwood Benn, M.P.

When one considers that over £3,000 million each year is spent on the maintenance of plant and buildings, the contribution that can be made to improving productivity throughout British industry by improving maintenance efficiency is clearly of vital importance. With such massive sums at stake, even a small percentage improvement will strengthen industrial performance and put an edge on Britain's export drive.

The Working Party on Maintenance Engineering was set up therefore to report to me on the most effective action the Ministry could take; it has met seven times under the Chairmanship of Mr. I. Maddock, Controller Industrial Technology in the Ministry, and the report follows.

I consider that the recommendations set out ways in which my Ministry can help industry in the field of maintenance engineering and that they will lead to substantial and much needed improvements. The basic problem underlying these recommendations is to convince management of the value of good maintenance and to make them aware of the standard they should set. I am therefore asking my officials to pursue the recommendations of the Working Party as vigorously as possible.

Finally, I thank the members of the Working Party for their contribution to its work.

Members of the Working Party

I. Maddock, CB OBE FRS	*Chairman*
R. G. Allen, DFC	Institution of Mechanical Engineers and Ronald Trist Controls Ltd.
E. B. Callick	G. & E. Bradley Ltd.
W. J. Currie	National Coal Board
A. J. Havelock	Ministry of Technology
F. B. Hayes	Imperial Chemical Industries Ltd.
L. E. House	Institution of Plant Engineers and Pilkington Brothers Ltd.
B. G. L. Jackman	Institution of Production Engineers and The Rover Co. Ltd.
W. K. Martin	John Player and Sons
A. Morton	English Electric Co. Ltd.
D. Parkes	*Maintenance Engineering*
R. A. Broom	*Secretary*

Observers

B. E. Drake	Ministry of Public Building and Works
H. A. Macdonald	Ministry of Technology

Report

1 Terms of reference

To consider the Ministry's internal report on Maintenance Engineering and to advise on the extent to which its recommendations should form the basis of Ministry policy.

2 Background

The attention of the Ministry was first drawn to the problems of maintenance engineering by Mr. Dennis Parkes, Managing Editor of *Maintenance Engineering*, who was convinced that they were of national significance, and that a number of facets deserved attention. He believed, for example, that if engineering designers took greater account of the maintenance needs of the finished product there would be great savings in maintenance costs over a wide range of industry. He wished to enhance the status of this aspect of engineering and encourage planned maintenance in the smaller firms, and suggested that the Government might help by giving publicity to an unglamorous but vital subject by setting up a Committee or other body to

(*a*) consider how smaller firms can be encouraged to undertake planned maintenance,

(*b*) try to set standards for maintenance and to disseminate maintenance information, and

(*c*) support research into the cost of maintenance work and the consequential effect of downtime whether planned or caused by breakdown.

As a result of this approach the Ministry sought the views of twenty-eight organizations and persons and from these views a report was prepared, the main recommendations of which are included in this report. Before acting on the report it was decided that the Ministry should seek advice from industry on the extent to which its recommendations were a satisfactory basis for Ministry policy. The present Working Party was therefore set up, and our report follows.

3 Field of the investigation

We found that there were no accurate economic data on maintenance engineering. The cost to the country of maintenance was not known accurately enough and very little work had been done on the return from investment in maintenance, though a start had been made by Strathclyde University. We considered that the number of training and education courses available for craftsmen, technicians, technologists and engineers was meagre. There were no university courses leading to degrees in maintenance engineering, though short training courses were mounted at colleges of technology; none of the courses for the various Ordinary and Higher National Certificates and Diplomas dealt specifically with maintenance, nor did the City and Guilds of London Institute courses, though maintenance was a part of four of them.*

We considered that there was a need for the results of maintenance investigations to be fed back to engineering designers. The engineering designer has to take into account many aspects of his product: the problems posed by production techniques and the skills of labour, the user's needs, the cost, the need for reliability and the need for easy maintenance. It has also been suggested that even where users did report the results of their experience with a product, manufacturers tended to ignore this information. Reliability and ease of maintenance have so far not been given the importance they deserve.

Though efforts are being made by a number of separate organizations to give advice to industry there has been no one body to whom a firm can turn for guidance as to the best place to obtain advice.

There is little research into maintenance management, nor is there provision for gathering information on maintenance problems throughout industry so that difficulties common to a number of firms can be tackled.

Maintenance is not a glamorous subject and the maintenance engineer does not have the status of his colleague in other branches of engineering. Senior management therefore has to be convinced of the importance of the subject, needs to be awakened to the high costs of maintenance, its effects on productivity and the large gains to be made by improvements.

Our deliberations included consideration of a number of aspects of maintenance, concentrating on the national cost, research, training and education, advisory services, industrial activity and future action.

4 National Cost of Maintenance

The first essential task was to obtain more accurate economic data on maintenance engineering. Management must be made more aware of the high

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*The Working Party has noted that a recent editorial leader in *Maintenance Engineering* suggested that the time was now opportune for a significant gesture—the endowment of a chair of maintenance engineering. It is understood that at least one senior engineering institution and one university have reacted favourably to the idea.

costs involved. Installations are now more complex, production times tighter and labour is becoming progressively more expensive, so that efficient maintenance is increasingly more important. Machines that ten years ago were used 70% of the time now have utilization factors of 80% to 85%. The relative value to a company of machine availability and maintenance expenditure needs to be established. Existing work in this field should be better publicized and further examinations undertaken.

These conclusions led to a recommendation that the Ministry should commission a survey to establish the national cost of maintenance engineering in the manufacturing industries and to discover the scope for improvements. In our view time was so pressing on this that it was decided to proceed with this activity before completing our deliberations. The Ministry therefore placed a contract with management consultants with the following terms of reference:

To establish

(*a*) the current overall costs of maintenance engineering work,

(*b*) the scope for reduction of these costs without detriment to production, and

(*c*) in what proportion of firms visited production suffers due to inadequate maintenance and in what major respects.

The consultants' report was presented in May 1969, and a précis appears in the Appendix. It established that the direct cost of maintenance engineering in the manufacturing industries was about £1,100m a year. (This figure would be over £3,000m if building maintenance, and plant maintenance in the nationalized and service industries were included.) A small percentage improvement in efficiency would give a considerable saving in money terms. The report answered the other questions put to consultants, and also pointed the way towards further research and the amount of other activity required.

5 Training and education

When the Ministry of Technology first sought the views of industry on maintenance engineering it was clear from the replies that lack of training and education of maintenance engineers and technicians was an important aspect of the present state of maintenance engineering. The National Coal Board, the Institution of Plant Engineers, the Institution of Production

Engineers, the Production Engineering Research Association, the Ministry of Defence (Directorate of Dockyards and Maintenance) and the Engineering Industry Training Board in particular stressed the need for adequate training. We agree that further effort in this area is required.

Maintenance personnel properly selected and given the necessary training can achieve savings for an organization through their contribution towards optimizing the productivity of the plant. Investment in costly machinery without comparable investment in competent people is poor management. An increasing amount of complex and often automated equipment is being introduced and this gives rise to the need for maintenance men, both engineers and technicians, to have greater and more flexible skills. It is also clear to us that senior management and staff employed on production need to be more aware of the need and usefulness of maintenance; similarly, staff employed on maintenance need to be aware of the problems of production.

Under the Industrial Training Act 1964, a number of industry training boards were set up but due to the very nature of the subject no one board has overall responsibility for maintenance of plant and equipment. It is understood from the Department of Employment and Productivity, which has Government responsibility for industrial training, that because of its major interest in the matter the Engineering Industry Training Board will have general responsibility for making recommendations about the standards and training programmes for maintenance craftsmen, technicians and engineers. Other bodies known to be interested are the City and Guilds of London Institute, the Iron and Steel Industry Training Board, who have been given responsibility for co-ordinating the training requirement for craftsmen and technicians responsible for instrument maintenance, the United Kingdom Automation Council, who have published *Investing in technicians, education and training needs for process automation and technology* and the Haselgrave Committee who are examining the structure of further education courses for technicians and have received evidence from a wide range of sources.

Whilst being aware that the Department of Employment and Productivity know of the need to train maintenance workers within each industry, we consider that there is a need to look at maintenance education and training as a whole and we consider that some thorough action to ensure adequate education and training is required. At our request, the Ministry of Technology invited the Department of Employment and Productivity to comment on our paper on training and education including the supplementary paper on management training. We further recommend that a Joint Committee of

Industrial Training Boards, augmented by other organizations having major interests, should be set up in accordance with the agreed procedures laid down in Central Training Council Memorandum No. 7 to ensure that proper attention is given to maintenance education and training as a whole.

6 National Maintenance Centre

The organization of and responsibility for maintenance engineering activities vary from enterprise to enterprise, even within the same industry. Generally speaking, however, the larger enterprises have professionally trained engineers in charge of the maintenance departments. Even where these executives have received education and training in engineering disciplines, comparatively few have received formal training in maintenance management. In the smaller enterprises it is common to find that maintenance is the direct responsibility of the works manager or similar executive, with a foreman or chargehand supervising the work.

During the past thirty years or so there has been a growing acceptance in the more enlightened enterprises that the preventive aspects of maintenance may be economically more attractive than a breakdown repair policy, but that it is important to achieve the correct balance between preventive and corrective action for the individual circumstances which obtain.

When production plant is simple in character, in labour intensive industries or in single shift operation, there is obviously limited incentive to improve maintenance effectiveness. But when plant becomes complex, costly and is operated continuously—and such plant is becoming more common—the maintenance effectiveness becomes of great importance.

Observations throughout the country suggest that maintenance management practices and maintenance technology are not as good as they should be. The need for advice, information and assistance for the improvement of maintenance engineering effectiveness seems to be greatest in the small and medium sized organizations.

We therefore considered what organizations there are which offer advice, information and assistance on the subject. Among the more important are:

(*a*) The Institution of Plant Engineers, a professional body closely associated with maintenance engineering, the Institution of Electrical Engineers and the Institution of Mechanical Engineers.

(*b*) Throughout the country there are about thirty Maintenance Associations which are independent local groups of maintenance engineers and maintenance managers. They hold meetings and generally provide both a forum for discussion and personal contact between the members. Since 9th October 1968 the Associations have been linked by the British Council of Maintenance Associations. At its first meeting the Council emphasized that the strength of the Maintenance Association movement lay in the fact that it was not a qualifying body.

(*c*) The British Productivity Council has a number of maintenance study groups within the local productivity associations. These groups are integrated with the independently formed Maintenance Associations to provide more effective coverage of the country. They hold seminars on maintenance and their productivity officers attached to the local productivity associations form a valuable source of direct contact with industry.

(*d*) The Ministry of Technology's Regional Organization, covering all Britain, gives advice to industry on all technological problems. The Industrial Liaison Officers in over eighty colleges and universities have the backing of academic staff in performing a similar service.

(*e*) The Production Engineering Research Association has for some time offered advice on planned maintenance. This was primarily concerned with machine tools and similar engineering plant but the scope has been extended.

(*f*) Some colleges of technology offer courses in planned maintenance, for example Slough College of Technology and the Medway and Maidstone College of Technology.

(*g*) Further sources of advice are the manufacturers of equipment and materials and companies which provide contract services, though some of this advice may be commercially biased.

(*h*) Several management consultants offer advice on maintenance organization but do not usually undertake very small consultancies.

(*i*) A number of journals publicize the importance of maintenance engineering.

We consider that a significant body of advice, information and assistance is at present available from various sources; appropriately used this could contribute significantly to better maintenance effectiveness throughout the country and consequently to improved productivity. There is a need to educate those still unaware that their maintenance effectiveness could be improved, there is a need to cater for those who wish to solve their maintenance problems and there is a need to co-ordinate future study of maintenance engineering to avoid duplication of effort on research. No existing organization provides or is likely to be able to provide adequately for the needs which we have expressed. We therefore recommend the immediate setting up of a National Maintenance Centre with the following terms of reference:

(*a*) To co-ordinate present national effort on maintenance.

(*b*) To act as a publicity and information centre.

(*c*) To channel advice on maintenance techniques and problems, and to provide a consultancy service.

(*d*) To promote, run, co-ordinate and publicize courses on all aspects of maintenance and become the authority on maintenance education.

The Centre might with advantage be attached to a college or university with close links with a Ministry of Technology Low Cost Automation Centre. The management body should be the Steering Committee (see Section 8) and the Director.

7 Industrial experiments

For some time the Ministry has been considering ways of determining and demonstrating the most effective method of helping smaller industries and firms to improve productivity and hence export potential. One of the ways is to conduct what the Ministry has termed an industrial experiment.

In an industrial experiment it is proposed that the Ministry would aid a wide range of small and medium sized firms in a well-defined geographical area or in a particular industry. Support would be in the form of injecting into the firms technological and managerial aids judged to be worthwhile. They would be able to draw on various Government resources such as the Ministry's research stations, research associations, the Production Engineering Advisory Service and similar Ministry services, as well as appropriate departments of colleges of technology, universities and industrial consultants. The gains achieved as a result of introducing new techniques would be widely publicized.

In the context of maintenance engineering it is proposed that a study might be made of the maintenance problems of several small and medium sized engineering firms. Suitable maintenance procedures would then be introduced, and the benefits achieved assessed. The result would be a 'before and after' picture which would be given publicity to encourage other firms to examine their maintenance problems. One member of the Working Party, Mr R. G. Allen, made a preliminary investigation into the possibilities of pooling or centralizing maintenance facilities for a number of smaller companies in the Slough area. The Slough Industrial estate, being close to London and the airport and with many small manufacturing companies, seemed to be a good location for this experiment. Slough College of Technology is very interested in the project and is willing to undertake the Ministry of Technology study.

We therefore recommend that the possibilities of using grouped maintenance resources should be explored. The experiment should be divided into two phases.

Phase One would include a study of the maintenance requirements of a number of companies, a statistical analysis of their costs and problems and the preparation of a plan to pool existing resources. If an acceptable plan can be devised, then

Phase Two would include the implementation of this plan, recording of results, and the dissemination throughout industry generally of the method, and the lessons learned from it.

The Ministry is at present negotiating a contract for the study with Slough College of Technology; the Royal Aircraft Establishment, Farnborough, will give technical guidance and oversight to the project.

8 Steering Committee

We consider that the problems posed by a lack of awareness of the importance of maintenance will require sustained effort by the National Maintenance Centre, the Ministry of Technology and other bodies with an interest in this field. The survey conducted by management consultants indicates that the cost of maintenance is considerable and that there is sufficient scope for reducing this cost, or for getting better results for the same amount of money, to justify the Government taking further action. The report indicates areas for further research and indeed three such areas have already been considered by us. There is then a need for further action in the training and education of craftsmen, technicians, technologists, engineers and managers, in providing advice to small and medium sized companies with the aim of improving their maintenance performance, and in considering what further research is needed. We therefore recommend that a permanent steering committee should be set up to guide the various activities that have been started, or need to be started in the future. Such a steering committee should have for its Chairman a man in the public eye, but preferably without personal involvement in the maintenance field, so that no question of prejudice or self-interest would arise. The membership of the committee could be settled by drawing on industry, government and various professional institutions for its members.

9 Future research

Now that the survey into the cost of maintenance engineering is completed we consider that action should be initiated on the research projects which we have proposed. Two such projects which deserve mention are:

(*a*) A proposal for a cost/benefit study in small to medium sized firms in the carpet manufacturing industry. The study will identify the maintenance policies used, determine the distribution of costs of the various activities over the maintenance function and determine the nature and where possible the extent of the general company benefit from the maintenance function as it operates in each individual concern. The ultimate purpose is to identify the decision areas on which effort should be concentrated from a feasibility and value point of view, and to develop models for the most worthwhile ones for the improvement of such decision making. This study would be undertaken at the University of Strathclyde under the guidance of Professor D. White.

(*b*) A proposal for a study and report upon the maintenance engineering practices and attitudes of a significant sample of small companies engaged in the engineering industry, having a common linkage as component suppliers to the same major and large customer. The economic implications of these practices and attitudes will also be studied. This study would be undertaken by the University of Aston in Birmingham with the co-operation of the Rover Company.

10 Conclusions

In conclusion, we consider that too little is known in industry of the cost of maintenance, the reliability of machinery and the savings that can accrue from better methods. There is a need for better design for maintenance, education and training and feedback of information; in short a need for a more professional approach to the subject. We consider that there is a lack of publicity and awareness of the subject at all levels. It does not have the status of other branches of engineering and must be made a more acceptable subject. A possible method is to publicize the results of a study of maintenance in a group of companies. Many firms are unable to employ a manager full-time on maintenance and they in particular will need a central focal point to which they can turn for expert unbiased information and advice. There is a need for a body to co-ordinate national activities and to guide the limited amount of research required.

We are conscious of the fact that the work already in hand and that proposed will cost money. It is envisaged that this will be comparable at least with expenditure by the Ministry of Public Building and Works in the field of building maintenance. We are convinced, however, that the potential savings to the country are so great as to make this more than worthwhile and indeed vital to the nation's economy in so far as productivity and the competitiveness of our industry are concerned.

Summary of Recommendations

1. A Steering Committee should be set up to guide future activities.
2. Maintenance education and training as a whole must be examined and action taken to ensure adequate education and training. A Joint Committee of Industrial Training Boards augmented by other organizations having major interests should be set up to pursue this on an urgent basis.
3. A National Maintenance Centre should be set up.
4. The possibilities of using grouped maintenance resources should be explored.
5. Research into all aspects of maintenance engineering is required, and should be started soon, now that the results of the survey into the national cost of maintenance are known.

Appendix

Summary of P.A. Management Consultants Ltd. Report

In September 1968 P. A. Management Consultants were commissioned to carry out a study of engineering maintenance in British manufacturing industry, on behalf of the Ministry's Working Party on Maintenance Engineering (M-E). This is a summary of their report.

1 *Terms of reference.* The main questions put to consultants, and their answers in the report were as follows:

1.	What are the current overall costs of M-E work?	Direct costs of M-E in British Manufacturing Industry is £1,100m p.a.
2.(*a*)	What is the scope for reduction of these costs without detriment to production?	Maintenance staff productivity could be raised by 60%. Reduction of costs would be £200-£250m p.a.
2.(*b*)	In what proportion of firms visited does production suffer due to inadequate maintenance, and in what respects?	Inadequate maintenance affects production in at least 20% of firms, being loss of output from plant which might have been productive. Possible savings are £200 to £300m p.a.

Record keeping tends to be poor, so the estimates above have been made on the conservative side.

2 *Survey method.* The first part of the study involved selecting 738 firms in appropriate fashion to represent the manufacturing industry groups, all of whom were asked by the Ministry to take part. Of these, 515 agreed to do so, and were visited by the research team with a questionnaire. This was filled in as far as possible during the visit, and was then left behind for completion and return.

Of the 515 firms mentioned, 80 were selected for a visit in depth; this formed the second part of the study.

3 *General impression.* In general, it is found that improvements will best be obtained by raising the productivity of maintenance staff from the present low level; they rarely have professional qualifications, and they know little of planning, work measurement and control. Senior management avoid involvement, and this leads to low productivity and high over-manning.

4 *Productivity.* The average utilization of maintenance manpower is about 60% of the optimum. Production management dislike releasing machinery during normal working hours; this with overtime working for higher earnings reduces the tempo of activity.

5 *Planning.* Half the firms visited did not plan corrective maintenance and a third used no preventive maintenance. Where preventive maintenance was used, only half the firms used past records for assessing machinery selection and the best frequency of the work. Nearly two thirds of firms visited used no work measurement or pre-determined time standards. Only half of the firms kept records of down-time arising from inadequate maintenance, but cases occured of indirect benefits accruing from having done so.

6 *Accounting*. Three quarters of firms visited used budgets, but only half the budgets were effective. History and opinion were bases for one third of the budgets, instead of real quantified needs. Quick cost reporting for effective control existed in little more than one third of all firms.

Nearly half of the firms knew their direct maintenance costs, but only one (large) firm had quantified indirect costs due to down-time, etc. in meaningful terms. Lack of this knowledge means no direct measurement of the effectiveness of the maintenance force.

7 *Machine capacity*. Much machinery, which could be better used for production is in fact idle because management over-insure against breakdowns.

8 *Less significant areas*. Whereas items 4 to 7 represent significant areas of possible improvement, others which are less significant are:

- (*a*) Reduce demarcation between unions and trades, particularly in development areas.
- (*b*) Top management should realize that maintenance is more than a necessary evil.
- (*c*) Production management should learn that preventive maintenance can be a real benefit.
- (*d*) Improve pay and status of maintenance staff.
- (*e*) Control overtime effectively.
- (*f*) Train maintenance staff at all levels.
- (*g*) Improve facilities, space and methods.
- (*h*) Make more use of contractors.

9 *Re-deployment benefit*. Figures are worked out to show that 200,000 maintenance staff could be made available for production; if all could be employed, the Value Added would be about £300m.

10 *Recommendations*. The Ministry should select a limited number of industries which offer the greatest scope for improvement, and then choose a geographical area in which perhaps two examples of each industry are in operation. The chief executives and maintenance managers should be approached with an explanation of the benefits to be obtained from improved maintenance, a plan of implementation and an offer of assistance.

It is important that the action and the results should be publicized; an extension of the procedure to other firms and areas should follow.

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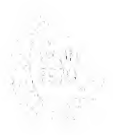

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